With such a GPS device for measuring the wave height and current direction and speed, because the floating body can float on seawater or fresh water, it will drift with waves, current, or tide when allowed to float on the sea, ocean, lake, marsh, or river, the movement of the floating body will be measured as three-dimensional position data by receiving the GPS signals with the GPS receiver installed on the floating body, and the position data relating to the measured three-dimensional position will be automatically recorded at least with the data recording unit. The current and swinging motion of the sea surface or water surface can be detected by means of the changes in the three-dimensional position of the floating body and the wave height and current direction and flow in fresh water or sea can be measured simultaneously. Because the cost of GPS antennas and GPS receivers has recently dropped and because only one such unit will suffice for the device for measuring the wave height and current direction and speed, they can be supplied as sensors at a low cost. As a result, a GPS device for measuring the wave height and current direction and speed can be implemented at a low cost and without complicating the structure. Further, because the GPS antenna, GPS receiver, and data recording unit are installed on the floating body, the position of the floating body can be directly measured by simply placing the floating body on seawater or fresh water, no limitation being placed on the zone for placing the measurement sensor. Three-dimensional positional observations can be thereafter conducted automatically in an unmanned mode and with a high measurement accuracy and the wave height and current direction and speed can be measured with a high accuracy.

In such a GPS device for measuring the wave height and current direction and speed, a data processing unit for processing the position data extracted from the data recording unit and calculating the wave height and current direction and speed in the point where the floating body is floating can be installed on the floating body. In the GPS device for measuring the wave height and current direction and speed that has been thus constructed, because the data processing unit for processing the position data extracted from the data recording unit is installed on the floating body, the processing of the position data and calculation of the wave height and current direction and speed in the point where the floating body is floating can be executed on the GPS device for measuring the wave height and current direction and speed.

In such a GPS device for measuring the wave height and current direction and speed, the data processing unit preferably conducts high-pass filter processing of the position data for extracting only the wave height components present in the high-frequency region in order to calculate the wave height, and conducts smoothing processing of the position data for extracting only the current direction and current speed components in order to calculate the current direction and current speed. Because the position data are measured only with the GPS receiver, they contain a position error of several dozen of meters which is caused by the GPS ephemeris error, atmosphere delay error, multipath error, and the like. Therefore, when the wave height is measured, the wave height cannot be detected with sufficient accuracy based only on the height data of the position data.

It is, however, noteworthy that measuring the absolute height of waves is not necessary to determine the wave height. Thus, the wave height can be measured if changes in the height of waves are measured. Moreover, when changes in the height of waves (become the wave height) were evaluated in the frequency regions, they were found to be present in the frequency region higher than that of the long-period (low-frequency) position error of GPS. A high-pass filter, which is used to employ this characteristic, has a function of extracting only the wave height component in the frequency range and removing the position error in the low-frequency range contained in the GPS position data and enables the wave height measurements that could not be conducted heretofore with the GPS receiver alone.

On the other hand, in case of current direction and speed measurements, the frequency range of data on current direction and speed is in the frequency band even lower than that of the position error of the data measured only with the GPS. The smoothing processing employs this characteristic and has a function of smoothing the position data, removing the high-frequency components, extracting only the current direction and speed component in the frequency range, and removing the position error contained in the GPS position data and enables the current direction and speed measurements that could not be conducted heretofore with the GPS receiver alone.

In such a GPS device for measuring the wave height and current direction and speed, a cut-off frequency of the high-pass filter and smoothing time of the smoothing processing can be set in the data processing unit so as to remove the errors contained in the position data. Such a setting of cut-off frequency and smoothing time in the data processing unit is appropriately conducted by taking into account the characteristics that appear in the position data, so as to remove most effectively the position error of measurement data obtained only with the GPS.

In this GPS device for measuring the wave height and current direction and speed, a transmitter for transmitting the computed data relating to the wave height and current direction and speed that have been calculated by the data processing unit is installed on the floating body. Installing the transmitter for transmitting the computed data relating to the wave height and current direction and speed on the floating body makes it possible to obtain the data relating to the wave height and current direction and speed from a remote location, without recovering the data processing unit installed on the floating body.

Further, the GPS system for measuring the wave height and current direction and speed in accordance with the present invention is composed of a GPS device for measuring the wave height and current direction and speed, comprising a floating body capable of floating on a fluid such as seawater, fresh water, and the like, a GPS antenna for receiving GPS signals, a GPS receiver for processing the GPS signals received by the GPS antenna and measuring the three-dimensional position, a data recording unit for recording the position data relating to the three-dimensional position measured by the GPS receiver, and a transmitter for transmitting the position data, wherein the GPS antenna, the GPS receiver, the data recording unit, and the transmitter are installed on the floating body, and a base station equipped with a receiver for receiving the position data transmitted from the transmitter and a data processing unit for processing the received position data and calculating the wave height and current direction and speed in the point where the floating body is floating.

With such a GPS system for measuring the wave height and current direction and speed, because the GPS device for measuring the wave height and current direction and speed, comprises the GPS antenna, GPS receiver, data recording unit, and transmitter, the unprocessed position data observed by the GPS system can be directly transmitted to the base